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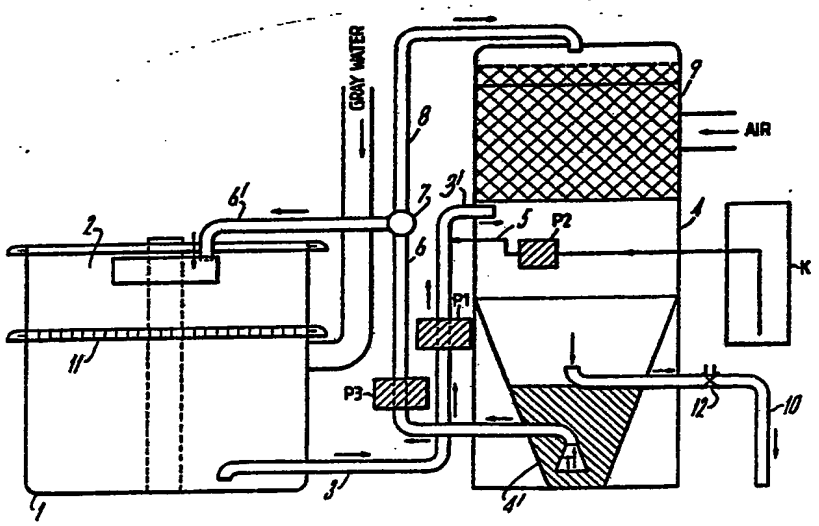
(54) Title: METHOD AND MEANS OF PURIFYING SEWAGE

(57) Abstract

A treatment plant for effluent comprises a precipitation tank (4), preferably designed with a lower conical portion (4'), a biological toilet (2), preferably a multi-chamber biological toilet, a biological filter (9), a deposition tank (1) provided below said biological toilet and separated from the latter by a perforated strainer bottom (11) provided between said biological toilet and sand deposition tank, piping (3, 3') for transferring effluent to said precipitation tank (4), means (K, P2, 5) for adding precipitants to said effluent in said precipitation tank (4), piping systems (6, 6') for transferring precipitated sludge from the lower portion (4') of said precipitation tank (4) to a chamber of said biological toilet (2), a piping system (P3, 6, 8) for circulating the chemically purified water across said biological filter (9), and a pipe (10) for discharging clarified water from said precipitation tank (4). A method for utilization of said plant is also shown.



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Method and means of purifying sewage.

The present invention relates to a method and a plant for purifying water, especially household effluent, i.e. bath water, dish washing water and possibly effluent from toilets and the like.

Sewer purification normally comprises at least one or several of the following methods of purification: i.e. primary treatment, biological treatment, and chemical treatment, precipitated particles being removed either by sedimentation, flotation, filtration, and possibly by centrifugation as well.

In biological treatment the contaminants present are decomposed by microorganisms, beeing uniformly suspended in the water to be treated in so called activated sludge plants and in biological filters, where the microorganisms are present on the surface of a carrier that is contacted with the water to be treated. In chemical treatment certain chemicals are added that cause the contaminants to precipitate, whereafter they may be removed mechanically.

Examples of suitable precipitants are soluble salts of trivalent metals, e.g. iron or aluminium.

Purification of effluent will normally comprise the three above mentioned methods of purification in said sequence, i.e. mechanical treatment, biological treatment, and chemical treatment.

Generally, the sludge formed in the biological treatment of the effluent and from the chemical treatment, also, has to be re-treated or conditioned before it is deposited. Said re-treatment of precipitated sludge can be time consuming for small plants intended for private use, and the user can find it difficult to get rid of the sludge in a satisfactory manner.

It is previously known to combine a biological purification plant with a biological dry closet, as e.g. stated in the Norwegian Patent Application No. 79 0196, wherein the

container portion of the dry closet is immerged in an equalizing basin inter alia to permit utilization of the effluent to heat the compost in the dry closet portion. A combination of a plant for effluent purification and a dry closet is also shown in the Norwegian Patent Application No. 78 2952, wherein sludge from a precipitation tank is pumped into a strainer or the like containing the dry closet portion. The water passing through said strainer is returned to the precipitation tank through a pipe. When the strainer is full it is emptied to the compost portion in the dry closet. In both known combinations a bio-filter of the kind mentioned above is used.

A bio-filter generally only having a purification effect in the order of 25% as regards phosphorous, this would mean that approx. 75% of the supplied phosphates are discharged from the above mentioned combination plants.

Thus, there is a demand for a method and a plant by the aid of which it is possible to remove a substantially larger portion of the phosphates present in the effluent. In the present method, thus, chemical precipitation is utilized combined with a special arrangement of the biological toilet in relation to a deposition tank.

In the present method effluent is purified in an efficient manner by the present purification plant which may suitably comprise a possibly separate deposition tank for effluent or the deposition tank may be a sedimentation tank, where precipitants are added. It is, however, prefered to use a separate deposition tank which makes it easier to check the process. Briefly, the method comprises pumping effluent from the deposition tank into the precipitation tank, and in connection with this immediately adding precipitants, whereupon the effluent with added chemicals is left in said precipitation tank, so that the precipitated material can sink to the bottom of the approximately conical precipitation tank.

After a predetermined interval the precipitated sludge is pumped out of the precipitation tank and into a decomposition chamber for sludge, said chamber preferably being a compartment of a biological toilet, as further described below. When the sludge transfer to said decomposition chamber is substantially completed, the residual effluent in said precipitation tank relieved of sludge is circulated across a biological filter for a predetermined time, and the effluent is, thus, subjected to further biological purification. When purification across the biological filter is substantially completed the treated effluent is again left for further precipitation of a minor amount of sludge settling on the bottom of the precipitation tank. The treated effluent is discharged through an outlet provided at a suitable distance from the bottom of said precipitation tank. The clarified water above said outlet can be discharged directly into a sewer pipe or a recipient, said treated water being substantially free from impurities that are harmful to the environment, especially phosphates. Said water is, thus, deemed harmless as regards pollution.

As mentioned above, the precipitants are added substantially at the same time as the effluent is transferred from the deposition tank to the precipitation tank, and the clarified water thas was treated with chemicals is, then, circulated across a biological filter. In certain cases, depending on the quality of the effluent, said effluent may at first be treated across a biological filter and the precipitants may be added afterwards. It is possible to combine the sequence by adding precipitants, then circulated the clarified water across a biological filter and then adding further precipitants to cause a secondary precipitation.

As will appear from the following, completely satisfactory purification of the effluent is, however, achieved when precipitants are added at first and clarification is carried out afterwards, whereafter further purification is achieved across the biological filter.

It is a feature of the present method that the precipitated sludge in the precipitation tank is transferred to a decomposition chamber without any further treatment. As mentioned, said chamber may preferably be a compartment of a multi-compartment biological toilet, e.g. of the kind described in NO-PS 128 957.

The multi-chamber biological toilet may advantageously be provided above the deposition tank and have a perforated bottom enabling excessive water being transferred with the pumped sludge to flow down and into said deposition tank. Excessive urine can also flow through the biological toilet into said deposition tank, so that there is no accumulation of urine in said biological toilet.

The deposition tank being provided below said biological toilet, the heat from the supplied effluent can be utilized to maintain suitable decomposition conditions in said biological toilet.

The present method will now be described with reference to the attached drawing diagrammatically showing a plant for carrying out the present method. The plant comprises a deposition tank 1 for effluent as well as strained water and excess urine, said strained water and excess urine coming from a multi-chamber biological toilet 2, provided above said plant and having a perforated bottom 11. The deposition tank is sized to receive the waste water from the household where said plant is installed over a period of 12-24 hours.

The waste water from tank 1 is transferred through pipes 3, 3' by pumps P1 to a precipitation tank 4, the lower portion of which 4' is conical to facilitate collection and concentration of the precipitated sludge. At the same time as the effluent is transferred from tank 1 to precipitation tank 4 chemicals are added by a pump from a container of chemicals K, e.g. via pipe 5 to pipe 3'. In this manner thorough mixture of effluent and the added chemicals, e.g. in the

form of an aqueous solution of aluminium sulphate, is secured.

Initiation of the pumping action for pumping effluent to the precipitation tank 4, and initiation of the pump for chemicals may be controlled by a conventional time-lag relay or another suitable control system. The transfer of effluent may either be time based or controlled by a level switch in the deposition tank (not shown).

When the effluent with the added precipitant has been introduced into said precipitation tank, it is left for a suitable period, e.g. 4 hours, which is enough for the system in question to let the precipitated sludge sink to the bottom 4' of precipitation chamber 4. Now the control system starts a pump P3, which removes the sludge by sucktion within a few minutes by the aid of discharge funnel T and transfers it to one of the chambers in the biological toilet 2 by three-way valve 7 and pipes 6 and 6'. After complete or substantially complete transference of ths sludge to said biological toilet the three-way valve changes over and the clarified water in tank 4 is circulated by the aid of pump P3 through pipe 8, across biological filter 9, wherein a biological purification of the effluent is obtained. Said biological filter is of a conventional kind, i.e. a filter provided with a filling having a large specific surface where an activated sludge may grow. The effluent is circulated for 6 to 7 hours across said biological filter. Then circulation pump 3 is stopped and the purified water is left for further 45 to 60 minutes. Any solid particles and sludge can, thus, sink below the level of a discharge pipe 10, through which the purified and clarified water is discharged by a suitable pum (not shown) and a magnetic valve controlled by the control unit. The pumped out clarified and purified water can, thus, be conducted directly to a municipal sewage or it may, if desired, be used for irrigation or the like.

The above described cycle is then repeated, and it will be understood that the retention period in the deposit tank

1 and in the precipitation tank 4 as well will be 12 hours. There will, thus, be no or very little preliminary fermentation or decomposition causing an unpleasant smell.

Said deposition tank being provided below a biological toilet in the preferred embodiment, it is possible to connect one or several water closets of the kind that use a minimal amount of wash water to said biological toilet. The utilized wash water will be filtrated through the perforated bottom of the biological toilet and flow down into said deposition tank, and after a retention period there of approx. 12 hours in the shown embodiment, the collected effluent will be transferred to the precipitation tank 4 for purification. In this manner the applicability of a biological toilet can be extended, since it is no longer necessary that faeces etc are supplied to the biological toilet via a straight drop tube.

The air generally extracted from a biofilter by a ventilator can in stead of being discharged into the atmosphere be conducted through the biofilter to enhance the biological purification.

Chamber 2, which in the embodiment described above is one of several chambers of a biological toilet, may naturally be any suitable tank, preferably provided above said deposition tank, and has a perforated bottom. Said perforated bottom may be covered with peat litter, conditioned bark of the kind that is used as a soil improving medium or the like, which will act as a filtering material for the sludge that is pumped out of the lower portion 4' of the precipitation tank 4.

The biological toilet shown in NO-PS No. 128 957 has a heating element provided in its bottom to enhance the bacteriological disintegration of faeces and other solid waste. In the shown embodiment such a heating element can either be eliminated or the current consumption may be reduced as it

is not necessary to use heat to evaporate the liquid trickling through the inner container of the toilet. Excessive liquid will now flow down into said deposition tank 1 and heat from the effluent in said deposition tank will both ensure an approximately correct temperature and a moist atmosphere in the biological toilet. It is, thus, possible to operate the biological toilet without supply of too much electric energy to maintain the correct temperature in said biological toilet.

The precipirated sludge from the precipitation tank 4 being collected in chamber 2, that may be one of several chambers of a biological toilet or a similar container, no problems will arise in connection with getting rid of the sludge that is disintegrated in the same manner as in a biological toilet of the kind that is described in NO-PS No. 128 957, that is, in fact officially accepted as being harmless to environment.

The amount of supplied precipitants is determined empirically from the size of the plant and the load it is subjected to, and the concentration and composition of the supplied precipitant is easily adapted to the actual conditions for obtaining an optimal precipitation, especially of the present phosphates.

The completery purified water that is discharged from the precipitation tank 4 via pipe 10 may be checked by the user as to its content of phosphates and its pH by simple methods of analysis generally based on a colorimetric measurement.

During operation of a test plant such simple methods of analysis were found satisfactory and analyses carried out by The laboratory of water analysis in Buskerud, Norway, showed that the content of phosphorous in the effluent transferred from the deposition tank 1 to the precipitation tank 4 was 11 mg/l. After precipitation and purification across a biological filter as described above the water was analysed

approximately 12 hours later, before being discharged via pipe 10. It showed a total content of phosphorous of 0,68 mg/l, which is far below the present requirements as regards the content of phosphorous in effluent.

A plant as described above was tested in a household of 3 persons and all waste water from utility sinks etc. was conducted to the deposition container, whereas faeces, urine and kitchen waste were deposited in one of the chambers of a biological toilet of the kind described in NO-PS No. 128 957. The sludge pumped from the precipitation tank was conducted to another one of the chambers of the biological toilet. Said sludge is disintegrated and turned into a soil like structure in the same manner as faeces and kitchen waste that is disintegrated in the other chamber of the biological toilet. After a suitable period of disintegration it may be used as a nutritious soil improving substance together with the residual disintegrated material from the biological toilet.

As will appear from the above mentioned it is possible to remove fresh sludge from the precipitation tank in a simple manner and to collect said sludge in a chamber where the conditions for biological disintegration to a mold like material can easily be achieved. The necessary valves and pumps may be controlled by a suitable time relay or even better, by a programmable miro processor based unit, that is to day a standard commercially available product and is able to control a number of functions, e.g. the various pumps and valves necessary to carry out the above described method. Another advantage of the present method and plant is that the biological filter will not degenerate during possible non-use due to a vacation, because liquid will be circulated across said biological filter as well as through the sludge collected in chamber 2, so that the biological filter will neither dry up og "die" because of lack of nutrition.

When a suitable amount of sludge has been collected in cham-

ber 2 said chamber may be turned if a biological toilet of the above mentioned kind is used.Thus, sludge will then be collected in another chamber and the filled chamber is left for composting for a suitable period.

To promote flocculation after addition of chemicals the effluent transferred to tank 4' is cautiously agitated. Such a cautious agitation or movement of the effluent in tank 4' can be achieved by a heating element provided around a portion of the tank 4' or partly arranged within said tank. This heating, preferably by an external heating element can be controlled by the above mentioned time relay . The heat induced agitation of the water may,thus, be maintained for a suitable periode, e.g. for 20 to 60 minutes.

As previously mentioned, the present method and plant have the advantage that the biological filter will not dry up or "die" due to lack of nutrition when the users are absent, e. g. due to vacation. In this connection, it proved advantageous to adjust the control device for introducing a suitable amount of fresh water, e.g. 30-50 l/day during a period when the users are absent. In this manner a certain amount of fresh water is added to the circulated liquid.

CLAIMS:

1. A method for purifying effluent from at least one household, wherein the effluent is subjected to precipitation treatment and precipitated sludge is transferred to a biological toilet for composting, c h a r a c t e r i z e d i n that said effluent is collected in a deposition tank and is then transferred to a precipitation tank, where a precipitant is added, and that precipitated sludge after a period of rest is transferred to a biological toilet, and that excessive water in the sludge is permitted to flow down into the deposition tank below, and wherein the chemically purified water is then conducted across a biological filter for decomposition of organical material, whereafter the biologically purified water is left for clarification and the clarified water is discharged from the plant and is, if desired, conducted to sewage.

2. A plant for carrying out the method as claimed in claim 1, comprising a precipitation tank (4), preferably shaped with a lower conical portion (4'), a biological toilet (2), preferably a multi-chamber biological toilet, a biological filter (9), c h a r a c t e r i z e d i n a deposition tank (1), arranged below said biological toilet and separated from the latter by a perforated strainer bottom (11), provided between said biological toilet and said deposition tank, piping (3,3') for transferring effluent to the precipitation tank (4), means (K, P2, 5) for adding precipitants to the effluent in the precipitation tank (4), a piping system (6,6') for transferring precipitated sludge from the lower portion (4') of said precipitation tank (4) to a chamber in said biological toilet (2), a piping system (P3, 6,8) for circulating the chemically purified water across said biological filter (9), and a pipe (10) for discharging clarified water from said precipitation tank (4).

AMENDED CLAIMS

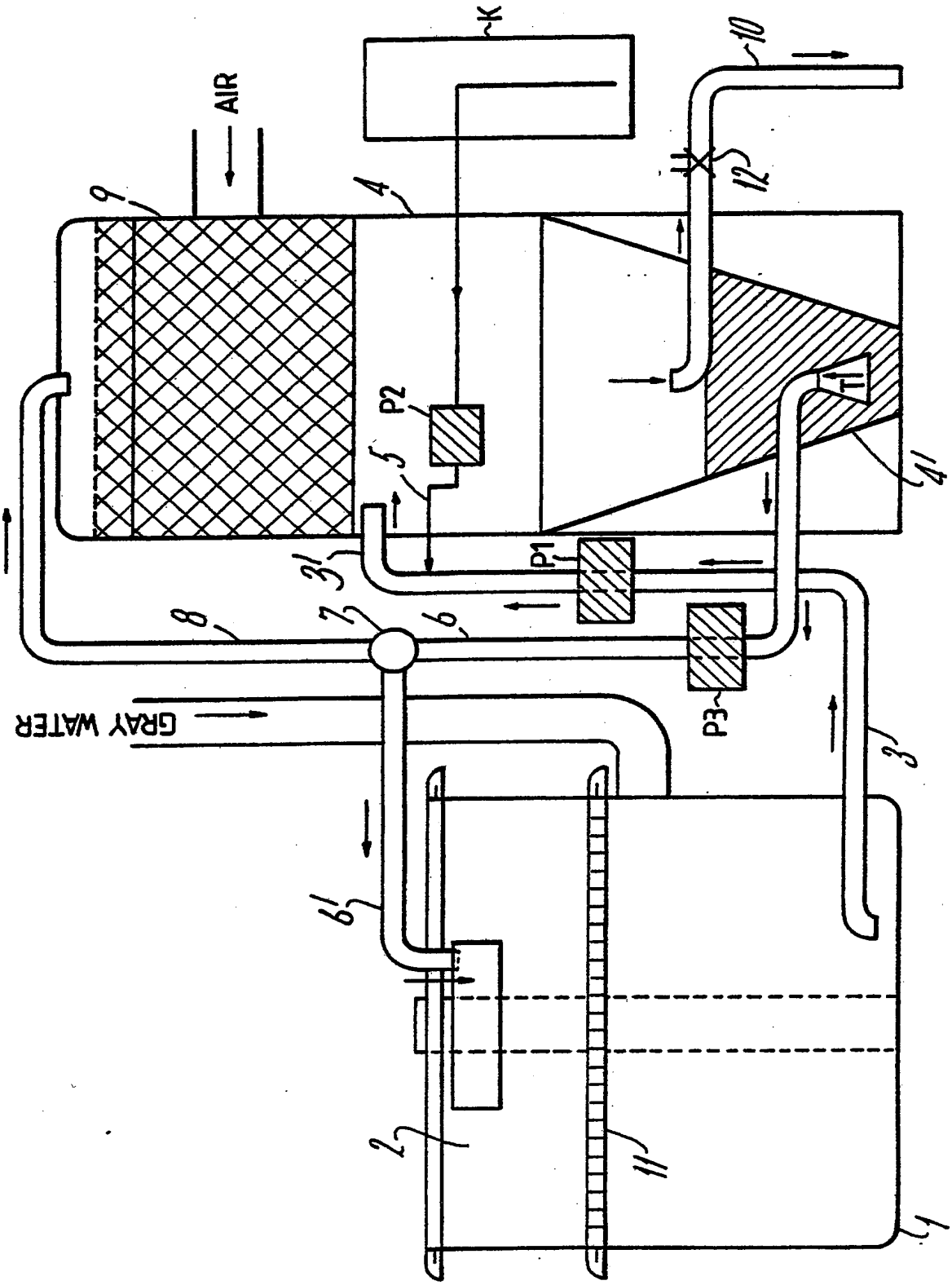
[received by the International Bureau on 11 May 1984 (11.05.84);
original claims 1 and 2 replaced by amended claims 1 to 3]

1. A method for purifying effluent (grey water) from at least one household, wherein the effluent is subjected to precipitation treatment and treatment in a biofilter and in which precipitated sludge for composting is transferred to a decomposition chamber, for instance a biotoilet (2), characterized in that said effluent is collected in a deposition tank (1) and is then transferred to a precipitation tank (4) where a precipitant is added, and that precipitated sludge after a period of rest is transferred to a decomposition tank and that excessive water in the sludge is permitted to flow down into the deposition tank (1) below and wherein the chemically purified water then is conducted accross a biological filter (9) for decomposition of organic material, whereafter the biologically purified water is left for clarification and that the clarified water is discharged from the plant and is, if desired, conducted to sewage.

2. Method in accordance with claim 1, characterized in that a small amount of fresh water periodically is added to the deposition tank (1) for instance two times in 24 hours.

3. A plant for carrying out the method as claimed in claim 1, comprising a precipitation tank (4), preferably shaped with a lower conical portion (4'), a decomposition tank (2), preferably biological toilet, a biological filter (9), characterized in a deposition tank (1), arranged below said biological toilet and separated from the latter by a perforated strainer bottom (11), provided between said biolgical toilet and said deposition tank, piping (3, 3') for transferring effluent to the precipitation tank (4), means (K, P2, 5) for adding precipitants to the effluent in the precipitation tank (4), a piping system (6, 6') for transferring precipitated sludge from the

lower portion (4') of said precipitation tank (4) to a chamber in said biological toilet (2), a piping system (P3, 6, 8) for circulating the chemically purified water across said biological filter (9), and a pipe (10) for discharging clarified water from said precipitation tank (4).



INTERNATIONAL SEARCH REPORT

International Application No PCT/NO83/00057

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC 3

C 02 F 1/00, 3/00, C 05 F 3/06

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC 3	A 47 K 11/00,02; C 02 F 1/00, 3/00; C 05 F 3/06, 9/02
US C1	71:9; 23:259.1; 210:9,18,151,180

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	US, A, 4 196 082 (T.T. SALOKANGAS ET AL) 1 April 1980 & GB, 2003460 FR, 2401878 DE, 2837125 AU, 39323/78 AT, 361413 CA, 1096063 AU, 517015 SE, 421610 SE, 7808917	1, 2
X	US, A, 4 213 864 (A. ASIKAINEN) 22 July 1980 & FR, 2415080 DE, 2902209 GB, 2015493 JP, 54149265 AT, 363870 CA, 1114959 SE, 7900520	1, 2

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
1984-03-14	1984 -03- 22
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Swedish Patent Office	Bo Bergström

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